DEC STD 116-5 Workmanship Standards Manual - Retaining Hardware and Mechanical Fasteners

DOCUMENT IDENTIFIER: A-DS-EL00116-05-0000 Rev F, 14-Jan-1991

ABSTRACT: This document provides the workmanship criteria to be applied to retaining hardware and mechanical fasteners used on Digital products. Retaining hardware includes screws, eyelets, and rivets.

APPLICABILITY: This standard is used as a training aid for new employees and is required for all personnel who manufacture and maintain Digital products.

STATUS: APPROVED 14-Jan-1991; use VTX SMC for current status.

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1 INTRODUCTION

This standard provides the workmanship criteria to be applied to Digital products. Retaining hardware and mechanical fasteners should be installed to meet workmanship guidelines described in this standard. This document should be used as a training guide and as a reference for all personnel who manufacture and maintain Digital products.

2 LEVELS OF ACCEPTABLE AND UNACCEPTABLE WORKMANSHIP

2.1 LEVELS OF ACCEPTABILITY

Optimal (Reference)

The nominal condition from which minimal acceptable and unacceptable variations are described.

Minimum Acceptable

The least degree of quality that will be accepted in Digital standards and engineering specifications.

Incidental Defect

A defect in a product that judgment and experience indicate will meet reliable standards of operation (form, fit, or function), but may depart from established standards and have little bearing on the effective use or operation of the unit, assembly, or system.

Unacceptable

The level below the incidental defect condition whereby a product that contains a critical or major defect must be either reworked to bring it to the acceptable condition or scrapped if it is not repairable. An exception to this is defined under subhead 2.2, Minor Defect.

NOTE

The above requirements shall prevail when specific information does not appear on engineering documentation. Engineering documentation may define specific quality requirements that take precedence over general workmanship standards.

2.2 LEVELS OF UNACCEPTABLE DEFECTS

Critical Defect

A critical defect is one that judgment and experience indicate could result in a potential hazard or unsafe condition for individuals using, maintaining, or assembling systems.

Critical defects must be reworked immediately to a safe condition or have the potential hazard removed.

No product with a critical defect may move through the process.

Major Defect

A major defect results in failure or reduces, mechanically or electrically, the usability of the unit, assembly, or system for its intended purposes. The unit will or does fail resulting from form, fit, or function.

Minor Defect

A defect that judgment and experience indicate may or can cause a form, fit, or functional failure in the unit. Rework of this condition is not necessary if the customer will accept the unit with the defect.

3 DEFINITIONS

anodize — To coat a metallic surface, electrolytically, with a protective oxide.

blind hole — A hole drilled into material without going completely through.

dielectric — A nonconductor of electricity.

grommet — An insulated protector used to cover sharp edges of a hole through which conductors are run.

ground

a. A conducting path, intentional or accidental, between an electric circuit or equipment and the earth, or some conducting body serving in place of the earth.

b. A reference point.

hardware

a. Electronic components, subassemblies, and finished pieces of equipment.

b. Bolts, nuts, fasteners, brackets, handles, and similar small structural parts used in assembling electronic equipment.

heatsink — A mass of metal that is added to a device or to which a device is attached for the purpose of absorbing and dissipating heat.

insulated — Separated from other conducting surfaces by a dielectric, offering a high resistance to the passage of current to disruptive discharge.

stripped thread — Occurs when a screw is overtightened and exceeds its torque limit. Stripped threads are evident when the screw keeps turning in its hole and will not tighten.

torque — Twisting force applied to a nut or screw to tighten it.

4 MACHINE SCREWS

4.1 PROTRUSION

The following describes acceptable and unacceptable thread protrusion conditions for machine screws.

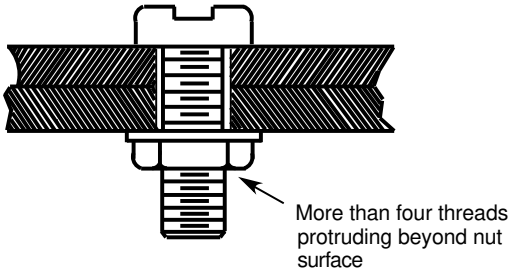
4.1.1 Optimal (Reference)

The screw shall protrude one thread as a minimum and seven as an absolute maximum, beyond the surface of the nut or insert. Thread protrusion must never cause interference to adjacent parts.

4.1.2 Unacceptable (Minor Defect)

Machine screws that protrude more than four threads beyond the nut surface are unacceptable. See Figure 1.

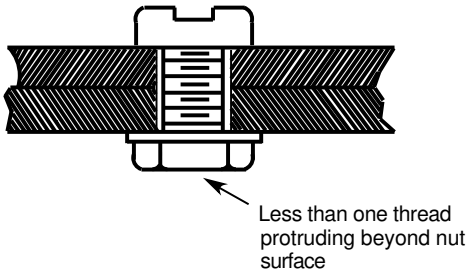
Figure 1: Machine Screw Protrusion: Unacceptable (Minor Defect)



4.1.3 Unacceptable (Major Defect)

Machine screws that are less than one thread from the bottom of the nut surface are unacceptable. See Figure 2.

Figure 2: Machine Screw Protrusion: Unacceptable (Major Defect)



4.2 SEATING

The following describes acceptable and unacceptable machine screw seating conditions.

4.2.1 Optimal (Reference)

All screws and mating nuts (when applicable) shall be securely installed and torqued to prevent loosening. All screws shall be torqued to their appropriate torque value according to A-SP-7665328-00-0, *Engineering Specification - General Torque Requirements,* unless otherwise specified in product engineering drawings. When screws are torqued, the mating materials shall be secured and no gaps between the materials shall be present.

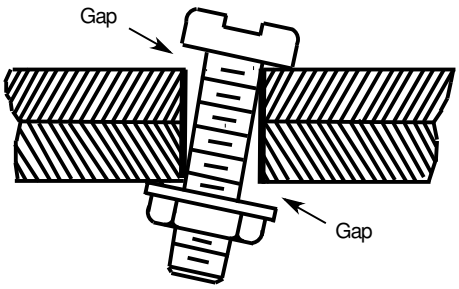
NOTE

Torque tools should be calibrated according to the guidelines described in A-SP-7665141-00-0, *Calibration, Maintenance, and Control of Test and Measurement Equipment.*

4.2.2 Unacceptable (Major Defect)

A tightened machine screw shall not be cocked or have a gap underneath the screw head. This situation may indicate cross-threading. See Figure 3.

Figure 3: Machine Screw Seating: Unacceptable (Major Defect)



4.3 BLIND HOLES

The following describes acceptable and unacceptable conditions for machine screws in blind holes.

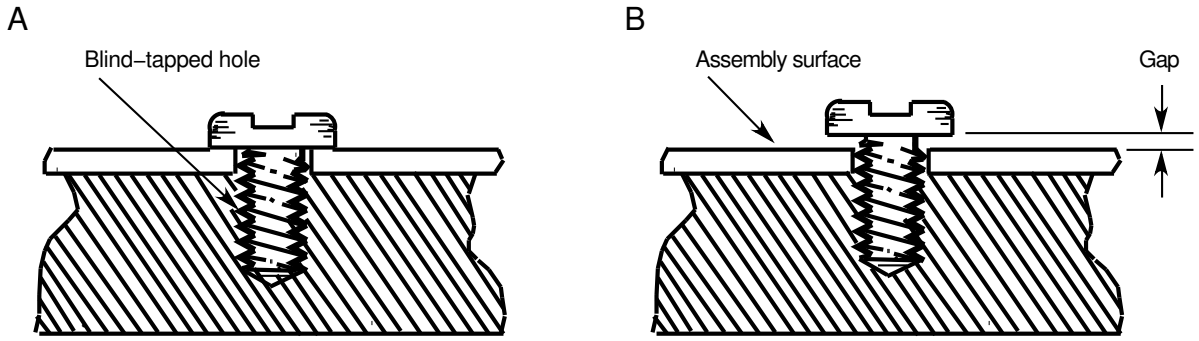
4.3.1 Optimal (Reference)

Screw assembled into a blind hole shall seat tightly. A gap is not acceptable between the screw head and assembly surface. See Figure 4A.

4.3.2 Unacceptable (Major Defect)

Screws assembled into blind holes that do not seat tightly between the screw head and the assembly surface are unacceptable. See Figure 4B.

Figure 4: Machine Screw - Blind Holes: Optimal (Reference) and Unacceptable



4.4 THREADS STRIPPED - UNACCEPTABLE (MAJOR DEFECT)

A stripped thread occurs when a screw is overtightened and exceeds its torque limit. Stripped threads are evident when the screw keeps turning in its hole and will not tighten.

4.5 METAL CHIPS AND FLAKES - MINIMUM ACCEPTABLE

A slight amount of metal dust is acceptable. Individual filings and chips of metal or plating should not exceed 1.0 mm (0.04 in) in length.

5 THREAD-ROLLING SCREWS

When using thread-rolling screws (TRS) in punched or extruded holes, the size or diameter of the hole becomes critical. Refer to A-PS-9000060-GS, *Thread-Rolling Screws - General Specification*, for recommended hole sizes. If the hole is too large or too small, the proper formation of the thread would be adversely affected. When the TRS is being driven, there is a certain amount of torque necessary to form the thread. The following conditions may occur if the hole is not the proper size.

a. If the hole is too small, it will be too tight for the screw and the setting torque will be reached prematurely, thus shutting off the torque driver before properly forming the thread.

b. If the hole is too big, thread formation would be insufficient, and the screw may strip out.

5.1 PROTRUSION

TRSs form their own threads through punched or extruded holes in low-carbon steel or aluminum castings. A TRS can also be used in machine screw applications with threaded inserts or tapped holes. This does not apply to trilobular-style thread-rolling screws.

Due to the taper or lead-in of the thread (approximately 2.5 to 3 threads), a certain thread protrusion is necessary for proper thread engagement.

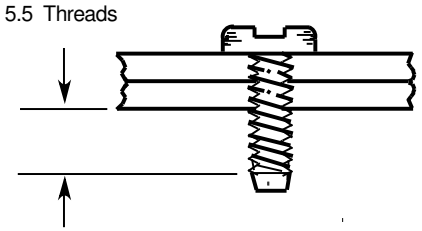
NOTE

Some TRSs have Type 1A (Pozidriv) recesses which can easily be confused with a Phillips recess. It is important to use the correct driver or bit for each application. Refer to Appendix A for bit and recess characteristics. A-PS-9000060-GS, *Thread-Rolling Screws - General Specification* also contains information on thread-rolling screws.[1]

5.1.1 Optimal (Reference)

Recommended thread protrusion is 5.5 threads. See Figure 5.

Figure 5: TRS Protrusion: Optimal (Reference)



[1] Pozidriv and Phillips are registered trademarks of the Phillips Screw Company

5.1.2 Unacceptable (Major Defect)

Thread protrusion is less than 3.5 threads or greater than 7.5 threads. Thread protrusion may be less than 3.5 if the engineering specification indicates that sufficient thread engagement is obtained for that application.

5.2 SEATING

Refer to subhead 4.2.1 for optimal (reference) seating conditions for thread-rolling screws.

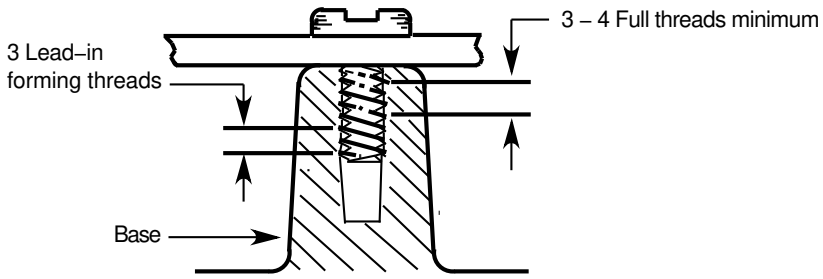
5.3 BLIND HOLES

The following describes acceptable and unacceptable conditions for thread-rolling screws in blind holes.

5.3.1 Optimal (Reference)

Thread-rolling screws should thread into the blind hole at the recommended drive torque. The head of the screw must seat properly at the recommended tightening torque. A minimum of three to four full threads should enter base component. See Figure 6.

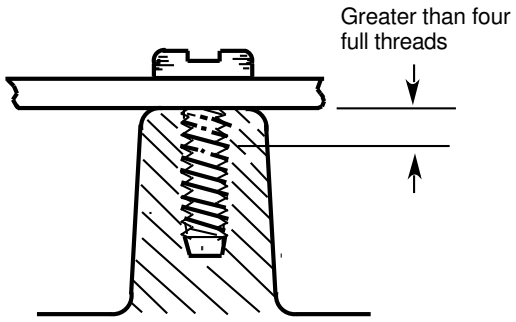
Figure 6: TRS Blind Holes: Optimal (Reference)



5.3.2 Unacceptable (Minor Defect)

More than four full threads entering base component, possibly causing higher than recommended drive torques. See Figure 7.

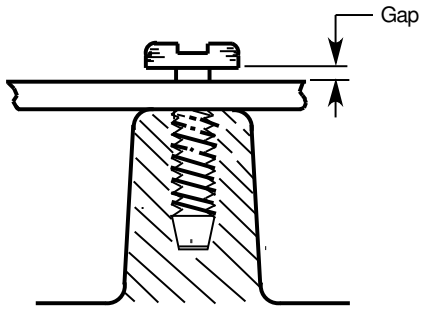
Figure 7: TRS Blind Holes: Unacceptable (Minor Defect)



5.3.3 Unacceptable (Major Defect)

TRS that do not seat tightly between the screw head and the assembly surface. See Figure 8.

Figure 8: TRS Blind Holes: Unacceptable (Major Defect)



5.4 THREADED HOLES

Thread-rolling screws, described in A-PS-9000060-GS, *Thread Rolling Screws - General Specification*, can be used in threaded holes as a direct replacement for machine screws. For example, a 6-32 TRS could be used in the same application as a 6-32 machine screw, provided screw protrusion requirements are met.

5.5 METAL CHIPS AND FLAKES - MINIMUM ACCEPTABLE

The function of TRS, while it forms through a punched or extruded hole, is to deform and work-harden the metal. It will not cut the metal like a tapping screw so no metal chips, filings, or flakes are present.

A slight amount of metal dust is acceptable. Individual filings and chips of metal or plating should not exceed 1.0 mm (0.04 in) in length.

6 FLATHEAD SCREWS

6.1 SEATING

The following describes acceptable and unacceptable flathead screw seating conditions.

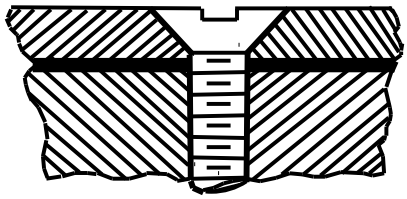
6.1.1 Optimal (Reference)

Flathead screws shall be flush with the surface when properly installed and tightened. The head protrusion shall not be greater than 0.38 mm (0.015 in) from the assembly surface. The head depression shall not be greater than 0.38 mm (0.015 in). See Figure 9.

NOTE

Flathead screws used on surfaces over moving assemblies (for example, sliding draws) must be flush or below the surface; protrusion is unacceptable.

Figure 9: Flathead Screws - Seating: Optimal (Reference)

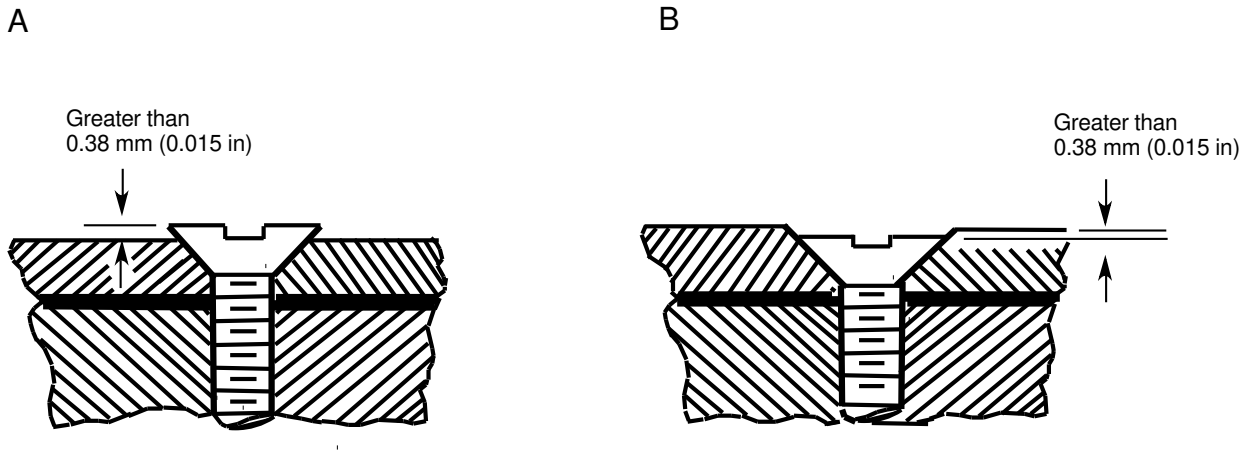


6.1.2 Unacceptable (Minor Defect)

a. Head depressed greater than 0.38 mm (0.015 in) from the assembly surface. See Figure 10A.

b. Head protruding greater than 0.38 mm (0.015 in) from the assembly surface. See Figure 10B.

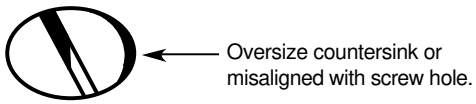
Figure 10: Flathead Screws - Seating: Unacceptable (Minor Defect)



6.1.3 Unacceptable (Major Defect)

Misalignment with the screw hole or gaps under the screw head in excess of 0.13 mm (0.005 in) for more than 40 percent of the head periphery is unacceptable. See Figure 11.

Figure 11: Flathead Screws - Seating: Unacceptable (Major Defect)



6.2 THREADS STRIPPED - UNACCEPTABLE (MAJOR DEFECT)

A stripped thread occurs when a screw is overtightened and exceeds its torque limit. Stripped threads are evident when the screw keeps turning in its hole and will not tighten.

7 HYDROGEN EMBRITTLEMENT (CRACKING)

High strength, high carbon steel fasteners that are plated (especially electroplated) and coated are vulnerable to hydrogen embrittlement. Hydrogen embrittlement causes fasteners to fail by cracking or actually fracturing the fastener into two separate pieces. This failure usually occurs after the fastener has been installed and tightened in its application.

7.1 UNACCEPTABLE (CRITICAL DEFECT)

Fasteners, such as screws or U-nuts, that are cracked or broken are unacceptable.

NOTE

If fractured fasteners are observed, hydrogen embrittlement testing should be performed on lot samples before continuing to use fasteners in question. Refer to subhead 7.2 for testing procedure.

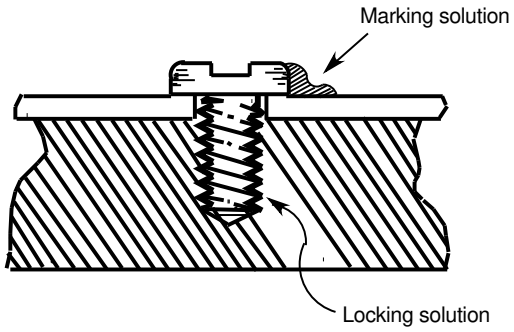
7.2 HYDROGEN EMBRITTLEMENT TEST

Procure a test plate and secure a number of sample fasteners, using the same torque application and requirements. Leave screws in test plate for approximately 48 hours. Loosen, then retorque fasteners to check for failure. Fasteners will most likely fail when retightened.

8 ADJUSTMENT SCREWS

The following information applies to adjusting screws that are secured or marked with locking solutions such as Loctite or insulating varnish at the intersection of the nut and screw after tightening. These substances must not be so thin that a droplet cannot be formed at the intersection between the nut and the screw after tightening. [2] See Figure 12.

Figure 12: Locking Solution Placement



[2] Loctite is a trademark of Loctite Corporation

8.1 LOCKING SOLUTIONS

8.1.1 Loctite

Loctite or a compatible substance is applied primarily to screw threads prior to insertion and not to the nut after hardware has been assembled. Substances such as Loctite do not have to be visible even though present.

8.1.2 Insulating Varnish

Upon completion of calibration or testing, adjustment screws may be marked with a small dot of insulating varnish at the junction of the screw head and the component body. Loctite should not be used for this application.

9 SWITCHES AND POTENTIOMETERS

Switches and potentiometers must operate freely with no binding or drag. Switches and potentiometers that bind or drag are considered major defects, and are, therefore, unacceptable.

10 RECESS CAM-OUT — UNACCEPTABLE (MAJOR DEFECT)

When the specified torque value for a screw cannot be reached due to bit cam-out or stripped recess, the screw must be removed and discarded. If the problem reoccurs, the bit size and bit wear should be checked. Refer to Appendix A for information regarding bit sizes for various screw recesses.

NOTE

If a cam-out problem reoccurs using Phillips screws, the recess should be checked. Phillips and Type 1A (Pozidriv) recesses are similar in appearance and sometimes hard to differentiate. Manufacturing should become more aware of the increasing use of Type 1A recesses in screws being used in some newer products.

11 REUSING LOCKING HARDWARE

The following criteria applies to locking hardware used in manufacturing assembly applications. Proper tools should be used on locking hardware. Refer to Appendix B for recommended nut and screw drivers.

11.1 MINIMUM ACCEPTABLE

It is acceptable to reuse cone type, split, and reverse serrated locking hardware multiple times. This is acceptable even in cases where locking hardware is removed from an assembly, breaking its original torque. However, internal and external tooth-locking washers should be replaced when it is possible. This includes hardware with locking devices (washer) attached.

11.2 UNACCEPTABLE (MINOR DEFECT)

Internal and external tooth-locking hardware must not be torqued a third time.

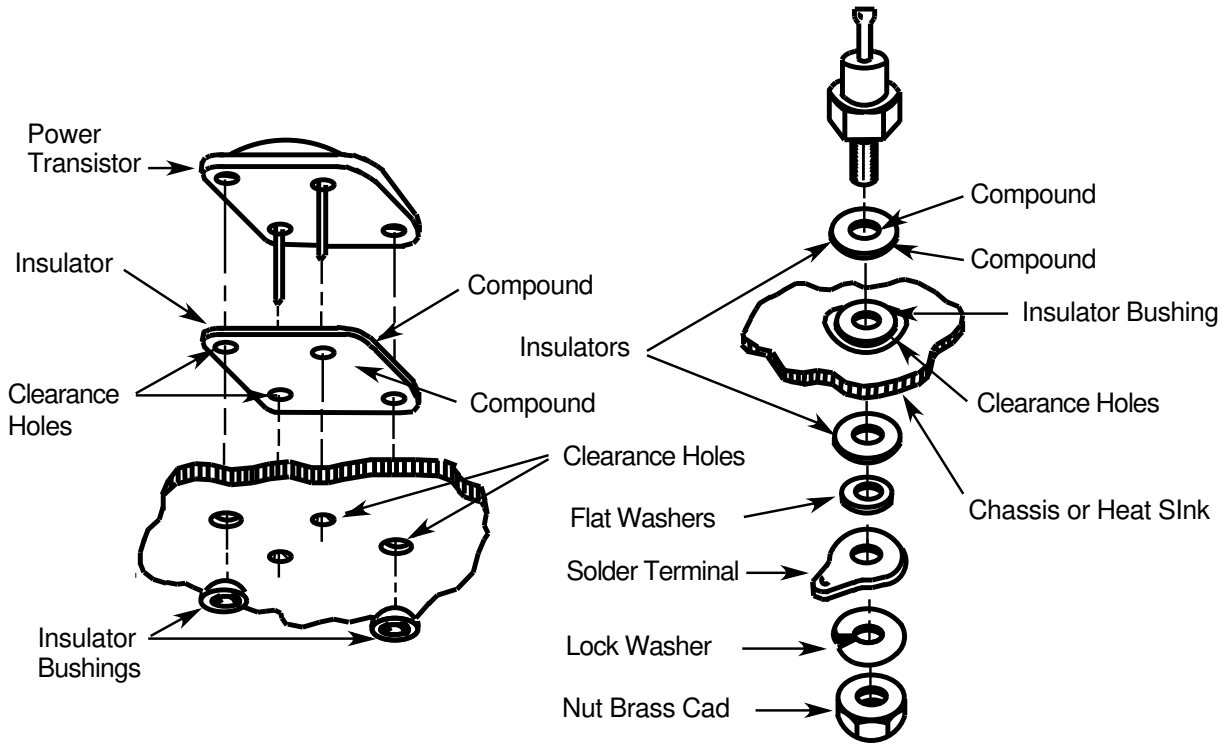
12 THERMAL COMPOUND

When specified, thermal compound shall be used on all transistors, diodes, silicon controlled rectifiers, and other components that are not mounted on heat sinks. Thermal compound shall be applied to one surface of each pair of mating surfaces. See Figure 13.

NOTE

A thin coating of thermal compound is all that is required. An insufficient amount of thermal compound is unacceptable. Large amounts of thermal compound will squeeze out from under the device and will be picked up by handling, contaminating the entire assembly with thermal compound. Some trace of compound should be visible at the end of the joint before cleaning.

Figure 13: Thermal Compound Placement



13 ROLLED FLANGED EYELETS

Rolled flanged eyelets with or without solder shall meet the following workmanship criteria.

a. Cracks or splits in the rolled portion of eyelets shall be permissible with the following limits.

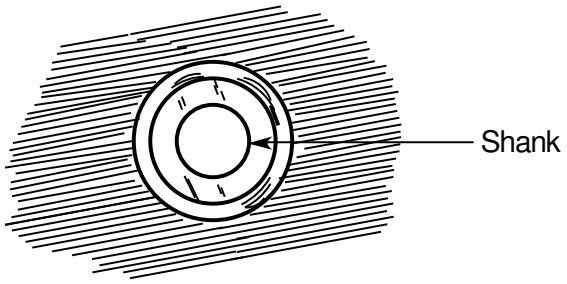
   No single part may have more than three cracks or splits around the outside diameter.
   No crack or split shall extend into the shank.

b. Eyelets shall be tight. The staking or rolling shall be uniform and the heads fully seated.

13.1 OPTIMAL (REFERENCE)

Eyelet is free of cracks, spits, and is tight. See Figure 14.

Figure 14: Rolled Flanged Eyelets - No Damage: Optimal (Reference)



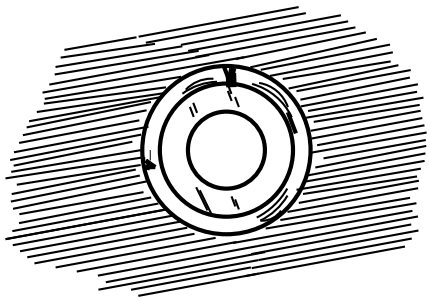
13.2 MINIMUM ACCEPTABLE

The following are minimum acceptable conditions for rolled flanged eyelets. See Figure 15.

a. Eyelet with a maximum of three cracks or splits.

b. Loose eyelet but mating parts cannot be moved.

Figure 15: Rolled Flanged Eyelets - Slight Damage: (Minimum Acceptable)



13.3 UNACCEPTABLE (MINOR DEFECTS)

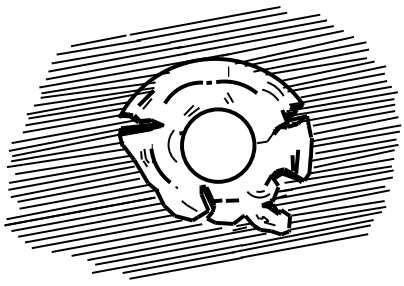
The following are unacceptable conditions for rolled flanged eyelets. See Figure 16.

a. Eyelet with major cracks or splits.

b. Severe deformation of eyelet.

c. Eyelets are loose and mating parts are easily moved.

Figure 16: Rolled Flanged Eyelets - Major Cracks and Splits: Unacceptable (Minor Defect)



13.4 UNACCEPTABLE (MAJOR DEFECT)

Cracks or splits extending into the shank is unacceptable.

14 BLIND RIVETS

A-PS-9000030-GS, *General Rivet Specification* contains information on rivet configurations and dimensions. The following information defines the inspection criteria for the following domehead non-structual rivets.

IFI 114, Non-Structual Break Mandrel
IFI 117, Non-Structual Rivet - Hollow Type
IFI 119, Structural Flush Break Pull Mandrel - Self Plugging
IFI 123, Structural Drive Pin
IFI 126, Break Mandrel Closed End
IFI 134, Structural (Monobolt) Multi-grip Flush Break Pull Mandrel

NOTE

Refer to A-SP-ELMF271-00-0, *Riveting Procedures and Specifications for Blind Rivets* or the appropriate purchase specification for additional information regarding rivets. Refer to Appendix C for information on removing rivets.

14.1 COMMON RIVET DEFECTS - UNACCEPTABLE (MAJOR DEFECT)

The following are unacceptable conditions generally detected when rivet defects are present.

a. Rivet is cocked more than 0.38 mm (0.015 in) on one surface. The gap shall not exceed 120 degrees of rivet head circumference. Use a feeler gauge to measure.

b. Riveted material is not held firmly together.

c. Body of rivet is split or cracked at bulb end.

14.2 INDIVIDUAL RIVET DEFECTS

14.2.1 IFI 114, Non-structual Break Mandrels - Unacceptable (Major Defect)

The following are defects commonly found on IFI 114, Non-structual Break Mandrels. See Figure 17.

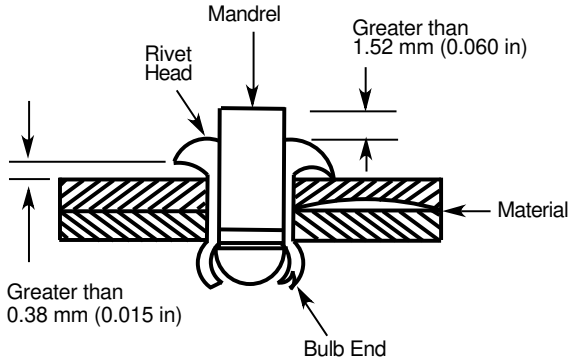
a. Riveted material is not held firmly together.

b. Body of rivet is split or cracked at bulb end.

c. Gap under rivet head is greater than 0.38 mm (0.015 in).

d. Mandrel breaks more than 1.52 mm (0.060 in) above rivet head.

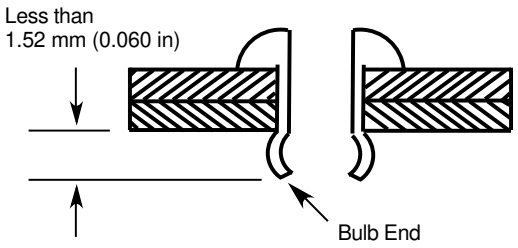
Figure 17: IFI 114, Non-structual Break Mandrels: Unacceptable (Major Defect)



14.2.2 IFI 117, Non-structural Rivet: Hollow Type - Unacceptable (Major Defect)

Bulb end does not protrude a minimum of 1.52 mm (0.060 in). See Figure 18.

Figure 18: IFI 117 Non-structural Rivet: Hollow Type: Unacceptable (Major Defect)



14.2.3 IFI 119, Structural Rivet Flush Break Pull Mandrel Self Plugging and IFI 126, Break Mandrel Closed End Blind Rivets - Unacceptable (Major Defect)

The following are defects commonly found on IFI 119, Structural Rivet Flush Break Pull Mandrel Self Plugging and IFI 126, Break Mandrel Closed End Blind Rivets. See Figure 19.

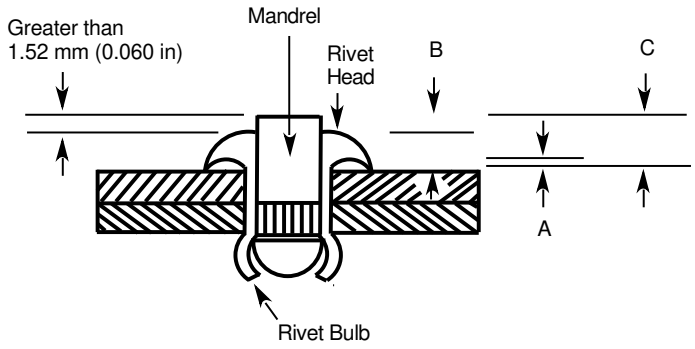
a. Mandrel breaks more than 1.52 mm (0.060 in) above rivet head.

b. Mandrel is not held firmly by rivet bulb.

c. Mandrel breaks within 25 percent of the top material.

A = Top material thickness times 25 percent
B = Rivet head height
A+B = Maximum allowed depth C

Figure 19: IFI 119, Structural Rivet Flush Break Pull Mandrel Self Plugging and IFI 126, Break Mandrel Closed End Blind Rivet: Unacceptable (Major Defect)



14.2.4 IFI 123, Structural Drive Pin Rivets - Unacceptable (Major Defect)

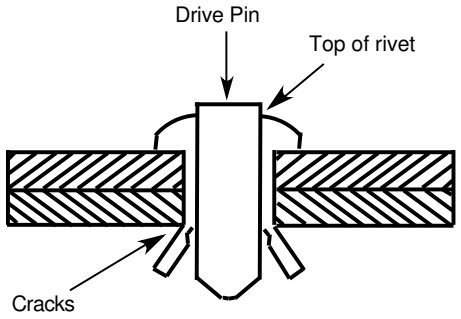
The following are defects commonly found on IFI 123, Structural Drive Pin Rivets. See Figure 20.

a. Drive pin is not flush with top of rivet.

b. Drive pin is not held firmly in place.

c. Cracks at junction of rivet and material.

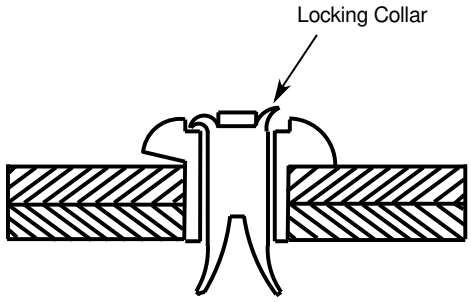
Figure 20: IFI 123, Structural Drive Pin Rivet: Unacceptable (Major Defect)



14.2.5 IFI 134, Structural (Monobolt) Multigrip Flush Break Pull Mandrel Blind Rivets - Unacceptable (Major Defect)

Mandrel is not locked in place by locking collar. Refer to Figure 21.

Figure 21: IFI 134, Structural (Monobolt) Multigrip Flush Break Pull Mandrel Blind Rivet: Unacceptable (Major Defect)



15 COUNTERSUNK BLIND RIVETS

This section defines the inspection criteria for flush peen and countersunk rivets. These drawings are guidelines for rivet inspection.

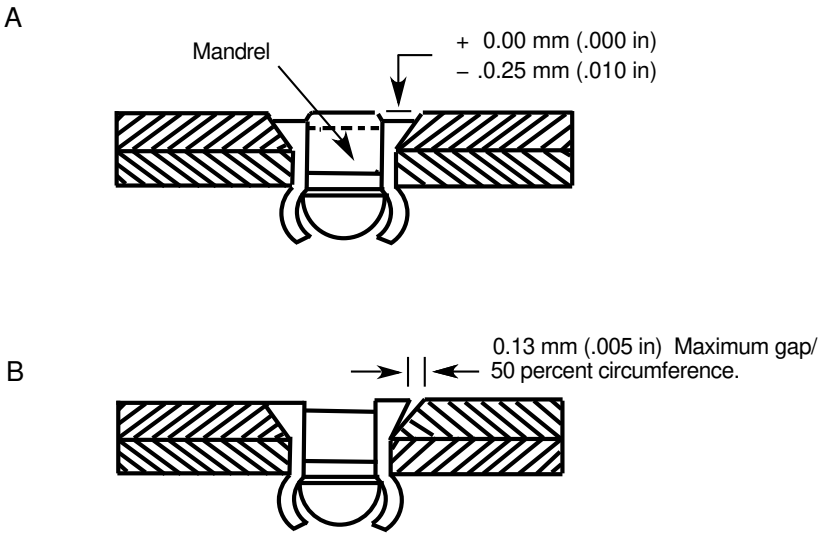
15.1 OPTIMAL (REFERENCE)

These rivets shall not project above the surface of the top material and shall be flush to 0.25 mm (0.010 in) below the surface. Refer to Figure 22A. They should completely fill the countersunk area. The bulb end of the flush rivet should have a minimum upset of 1.5 times the rivet shank diameter.

However, a gap of 0.13 mm (0.005 in) is allowed if it does not extend to the shank of the rivet and does not exceed 50 percent of the rivet circumference. In Figure 22B, the rivet mandrel is held firmly by the rivet body and the bulb has expanded 1.5 times the rivet shank.

The mandrel can break flush with the top material surface, or may be recessed into the rivet body. The mandrel must be secured with the rivet bulb.

Figure 22: Countersunk Rivet Depth: Optimal (Reference)



NOTE

The mandrel can break flush with the rivet head, or within 50 percent of the top material thickness for IFI 119 and 134 countersink styles. IFI 117 style will be hollow with no mandrel. For all others, the mandrel will break within the rivet body and be secured by the rivet bulb.

APPENDIX A BIT AND RECESS CHARACTERISTICS

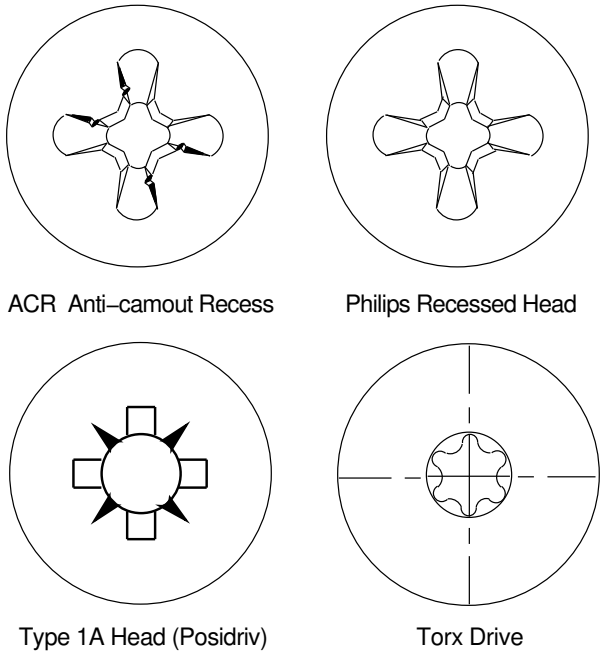
Table 1: Bit Sizes

Screw	Type 1A	ACR /Phillips	Torx Pan /Fillister	Torx Truss
4-40	PZ-1	P-1	T10	
6-32	PZ-2	P-1	T15	T10
8-32	PZ-2	P-2	T20	T15
10-32	PZ-2	P-2	T25	T20
1/4-20	PZ-2	P-3	T30	T25

A.1 RECESS AND BIT CHARACTERISTICS

The following information highlights some of the differences and characteristics of Type 1A and ACR/Phillips recesses and bits. [3]

Figure 23: Recess and Bit Heads



[3] ACR, Posidriv, and Phillips are registered trademarks of the Phillips Screw Company. Torx is a registered trademark of Camcar, Division of Textron Inc.

Table 2: Type 1A and ACR/Phillips Differences

Type 1A	ACR/Phillips
Radial grooves or markings (4) are located on top between the wings of recess.	Does not have markings on top of head.
Tiny valley or groove slants downward between recess wings.	Does not have this valley.
Driver bit has a small rib between the flanges, which is visible and is readily detectable with fingernail.	Does not have this rib.
Bit identification mark is "PZ".	Identification mark is "P" or "ACR".
Bit or driver does not fit well in a Phillips recess.	Driver will enter the Type 1A, but is not recommended.

APPENDIX B RECOMMENDED NUT AND SCREW DRIVERS

Table 3: Recommended Nut and Screw Drivers

Thread Size	Torque Range (in-lbs)	Handle	Clutch	Tool Number	Manufacturer	Type
2-40	2-4.5	Straight	One shot electric	CL-4000	Hios	Electric
2-56	1-21	Straight	Push to start	4RSA-10MQ	Cleco	
	2-4.5	Straight	Lever electric	CL-4000	Hios	
	2.5-21	Straight	Lever electric	CL-7000	Hios	
4-40	4-9	Straight	One shot push to start	2B88A-1200F	Desoutter	
	2.5-21	Straight	Lever electric	CL-7000	Hios	
	1.2-14	Straight	One shot	CL-6500	Hios	Electric
	5-8	Straight	One shot	2RSA-105B	Cleco	Air†
	5-20	Pistol	One shot	LUM14PR11	Atlas	Air
	5-20	Straight	One shot	LUM14PR11	Copco	Air
6-32	2-17	Straight	One shot lever	4RSAL-17CQ	Cleco	Air
	2.5-21		One shot	FS-7000	Hios	Electric†
	5-20	Pistol	One shot	LUM14PR11	A/C	Air
8-32	2-40	Pistol	One shot	44RSAPT-2BQ	Cleco	Air
	2-40	Straight	One shot	44RSAL-7BQ	Cleco	Air
	2.5-21	Straight	One shot	CL-7000	Hios	Electric†
	8-42	Pistol	One shot	F-9000/F-9001	Hios	Electric
	13-62	Straight	One shot	LUM24PR07	A/C	Air
10-32	8-42	Pistol	One shot electric	F-9000/F9001	Hios	Electric
	2-45	Pistol	One shot	44RSAPT-TBQ	Cleco	Air
	15-40	Pistol	One shot	CP2450-TRECQ4	C/P	Air
	13-62	Pistol	One shot	LUM24HR07	A/C	Air
1/4-20	48-72	Pistol	One shot	5CHR	Altas-Copco	
	20-160	Pistol	One shot	88RSAPT-5Q	Cleco	
	35-140	Pistol	One shot	CP2450-TRHCQ4	C/P	Air

†May be converted to pistol H10S part number 64341.

Table 3 (Cont.): Recommended Nut and Screw Drivers

Thread Size	Torque Range (in-lbs)	Handle	Clutch	Tool Number	Manufacturer	Type
		Right	One shot		A/C	Air /Pulse
5/16-18	20-160	Pistol	One shot	147NAL-6RA-12	Cleco	Air
	48-144	Angle	Auto	CP2460-LRFUN8	C/P	Air
3/8-16	168-312	Angle	One shot	147NAL-6RA-12	Cleco	
	108-300	Angle	One shot	CP3017-Tadrum	Chicago-Pneumatic	
	50-325	Horizontal	Ratchet	URW-10N	URYU	

APPENDIX C RIVET TOOLS AND REMOVAL PROCEDURE

C.1 RIVET REMOVAL

The following steps can be used to remove rivets.

1. Using a drift pin no larger than the mandrel (or a used mandrel), drive the mandrel out toward the bulb end.
2. Drill the rivet body out using a drill the same size as the rivet body, drilling the head side of the rivet. In some cases, pliers will be required to hold the bulb end to prevent the rivet from spinning.
3. Make sure the hole is clear of all rivet material before installing a new rivet.

C.2 SETTING TOOLS FOR RIVETS

Table 4, Recommended Tools for Rivets, shows a list of tools and the corresponding rivet grades that were evaluated and approved for manufacturers use.

Table 4: Recommended Tools for Rivets

Rivet Size (Inch)	IFI Standard	Manufacturer's Tool Number					
		Avdel		Cherry		USM	
		Tool No.	Weight (lbs)	Tool No.	Weight (lbs)	Tool No.	Weight (lbs)
3/32	114			GH702	3.5	MCS 510 PRG 510 PRG 511	4.3 4.0 4.0
1/8	114 – 119	734	3.3				
	117	7271 7273	5.22				
5/32	114 –	734	3.3	GH702	3.5	MCS 510 PRG 510 PRG 510	4.3 4.0 4.0
	114 – 119			GH703	5.0		
	117	7271 7273	5.2				
3/16	114 – 119 – 134			GH703 GH743	5.0 6.25	PRT 5300	
	117	7271 7273	5.2				
1/4	114 – 119 – 134			GH743	6.25	PRT 5600	4.77
	117	7271 7273	5.2				

Each tool in this chart requires special nosepieces that depend on the type and size of the rivet. Refer to the manufacturer's catalog for additional information. All tools are handheld except for tool number 7273 that is designed to be bench-mounted with a foot pedal operation.

APPENDIX D REFERENCED DOCUMENTS

D.1 EL-Class Digital Documents

EL-Class Number	Document Title
76-65141-00	*Calibration, Maintenance, and Control of Test and Measurement Equipment*
76-65328-00	*Engineering Specification - General Torque Requirements*
EL-MF271-00	*Riveting Procedures and Specifications for Blind Rivets*

Use VTX SMC to order copies of EL-class documents from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

D.2 Other Digital Documents

Document Number	Document Title
A-PS-9000030-GS	*General Rivet Specification*
A-PS-9000060-GS	*Thread Rolling Screws - General Specification*

D.3 Ordering Information

Following are the sources for documents not available from Standards and Methods Control.

- Central Specification Control Systems
  (NRO-5/M2), any Microfilm Reference File, or the SPOC System

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